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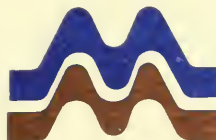
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MINING IMPACTS ON THE WAGE RATES
IN OTHER EMPLOYMENT SECTORS

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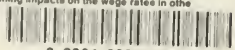
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MINING IMPACTS ON THE WAGE RATES
IN OTHER EMPLOYMENT SECTORS

by
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Prepared for:
The Decker Area Mines Comprehensive Social Sciences Study
Montana Department of State Lands
U.S. Office of Surface Mining and Reclamation

Prepared by:
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Billings, Montana

May 1983

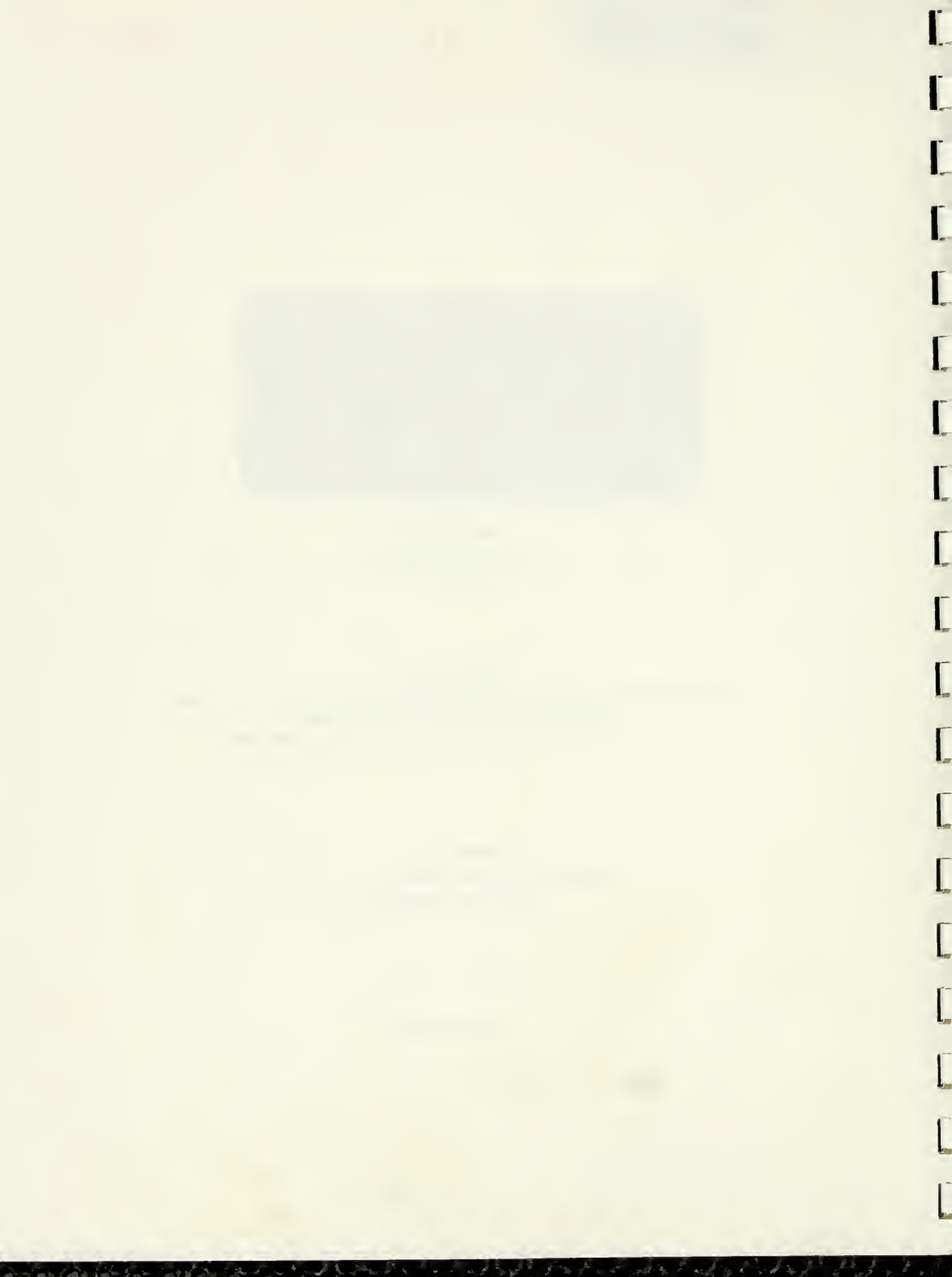
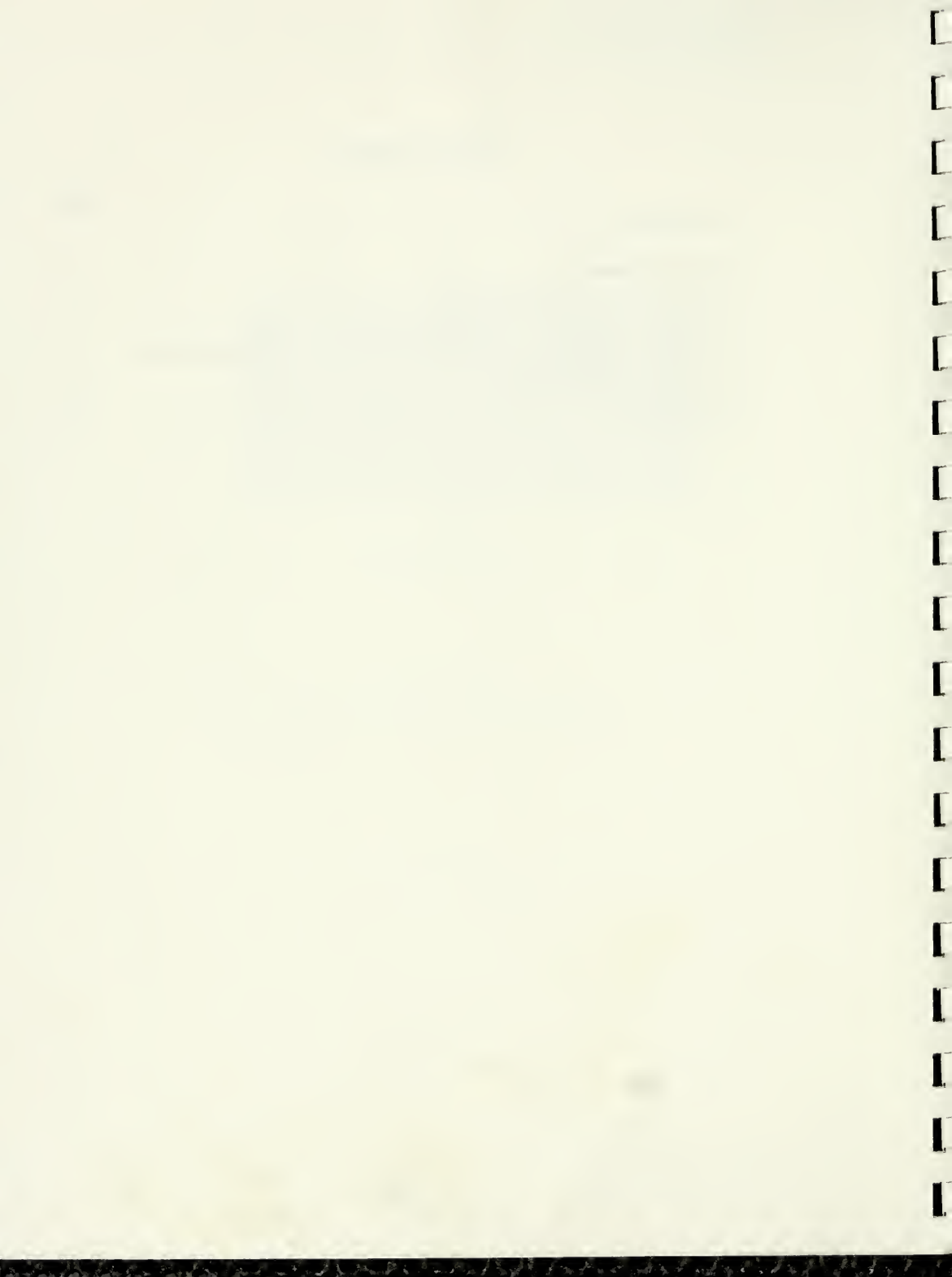


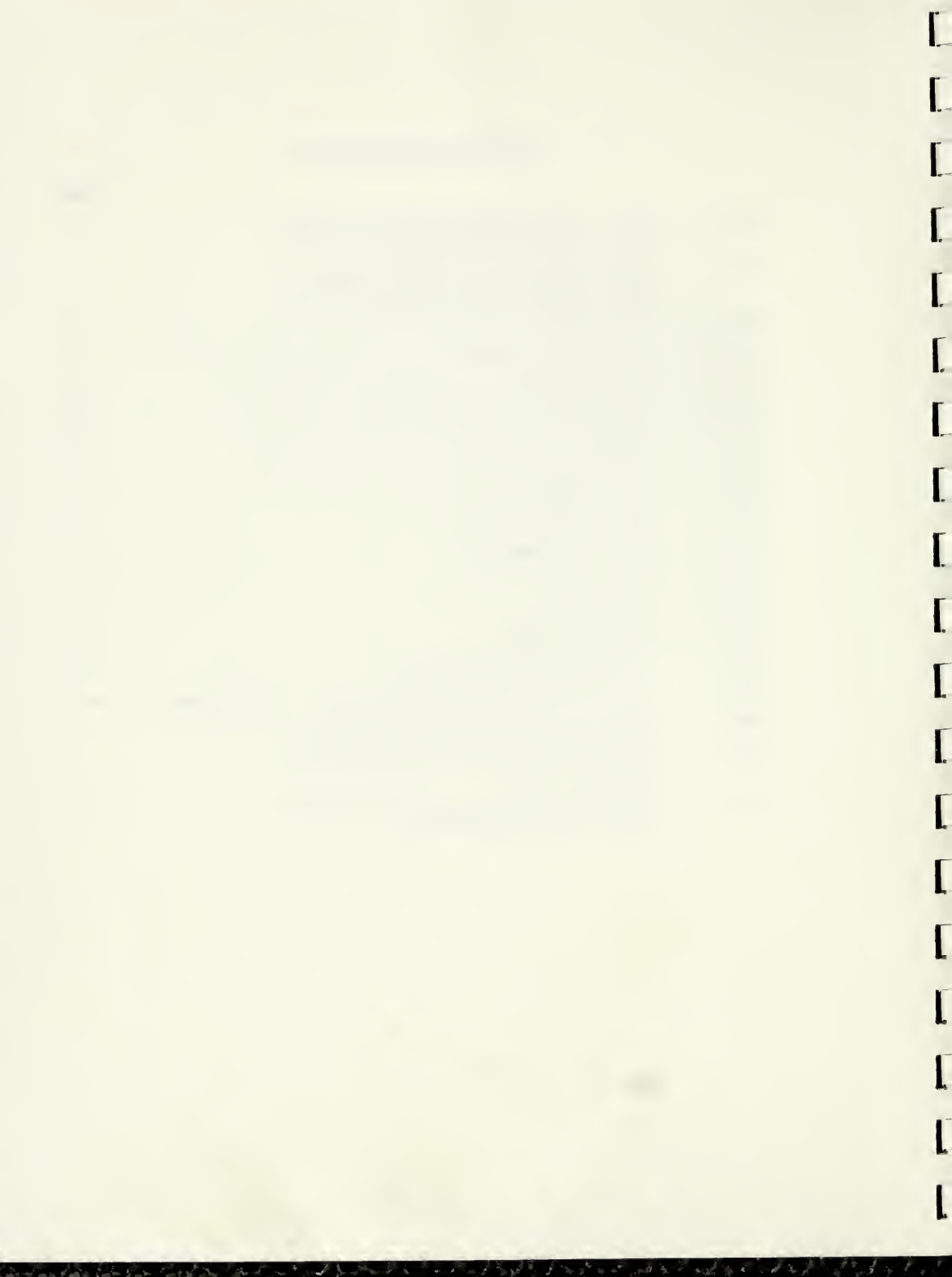
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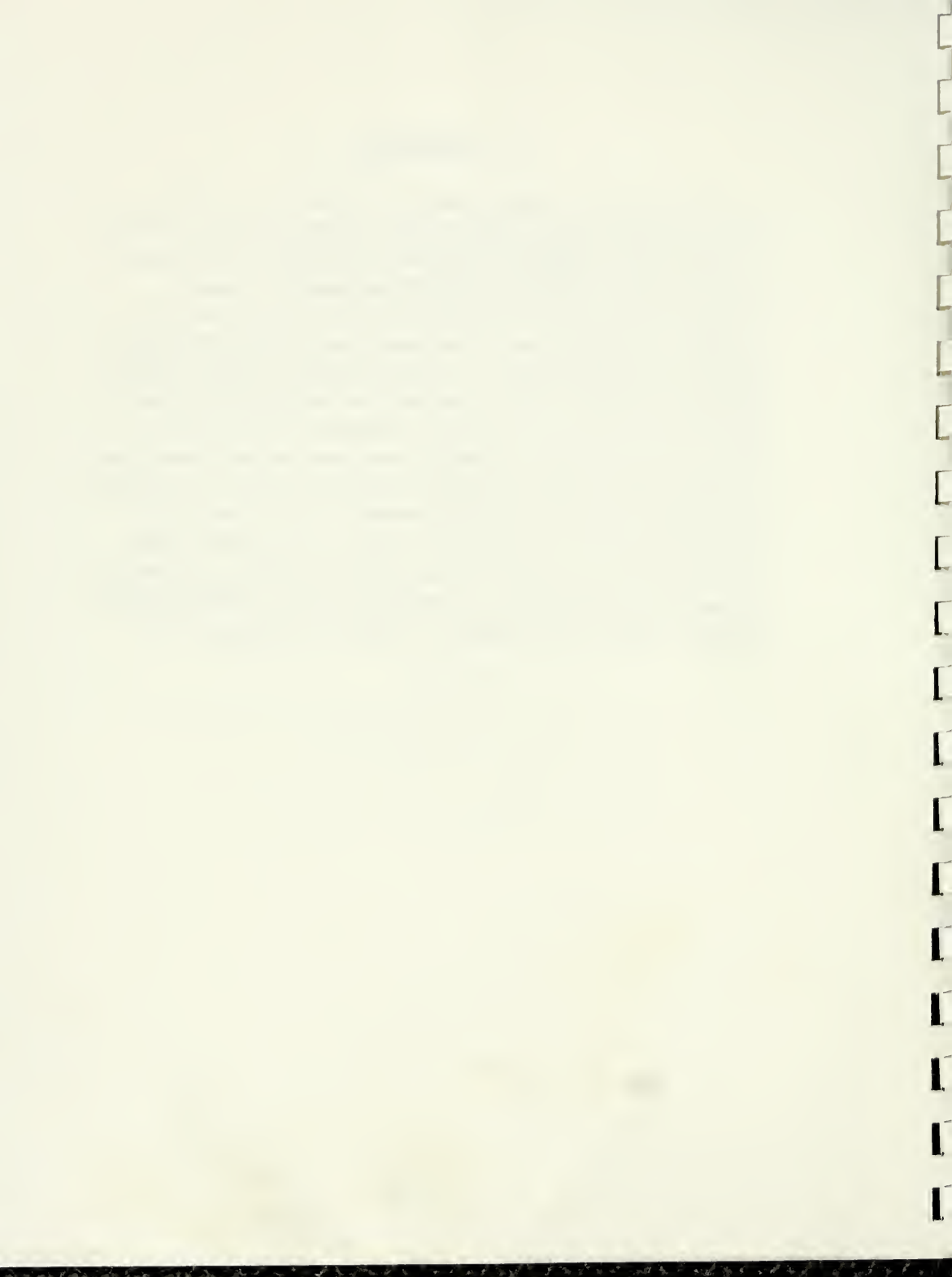
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1. INTRODUCTION

The rapid growth in energy resource development over the past decade, particularly in the Rocky Mountain states, has raised a number of issues in local communities regarding the effects of this growth on the local economy. An issue frequently mentioned is increased inflationary pressure due to rising housing costs and the competition for labor. The central theme of the competition for labor is that the creation of high paying jobs in the energy industries, such as mining, affects the wage rates in other sectors of the economy as they compete for the available labor. The intent of this paper is to examine the effects that wage rates in the mining sector have had on the wage rates in other sectors of the local economy in the Decker study area (Sheridan County, Wyoming and Big Horn County, Montana). The results of this examination are useful for providing insight into the possible future relationships and impacts from renewed energy development. All data in this report are from the Bureau of Economic Analysis, Regional Economic Information System (U.S. Department of Commerce, Washington, D.C.).

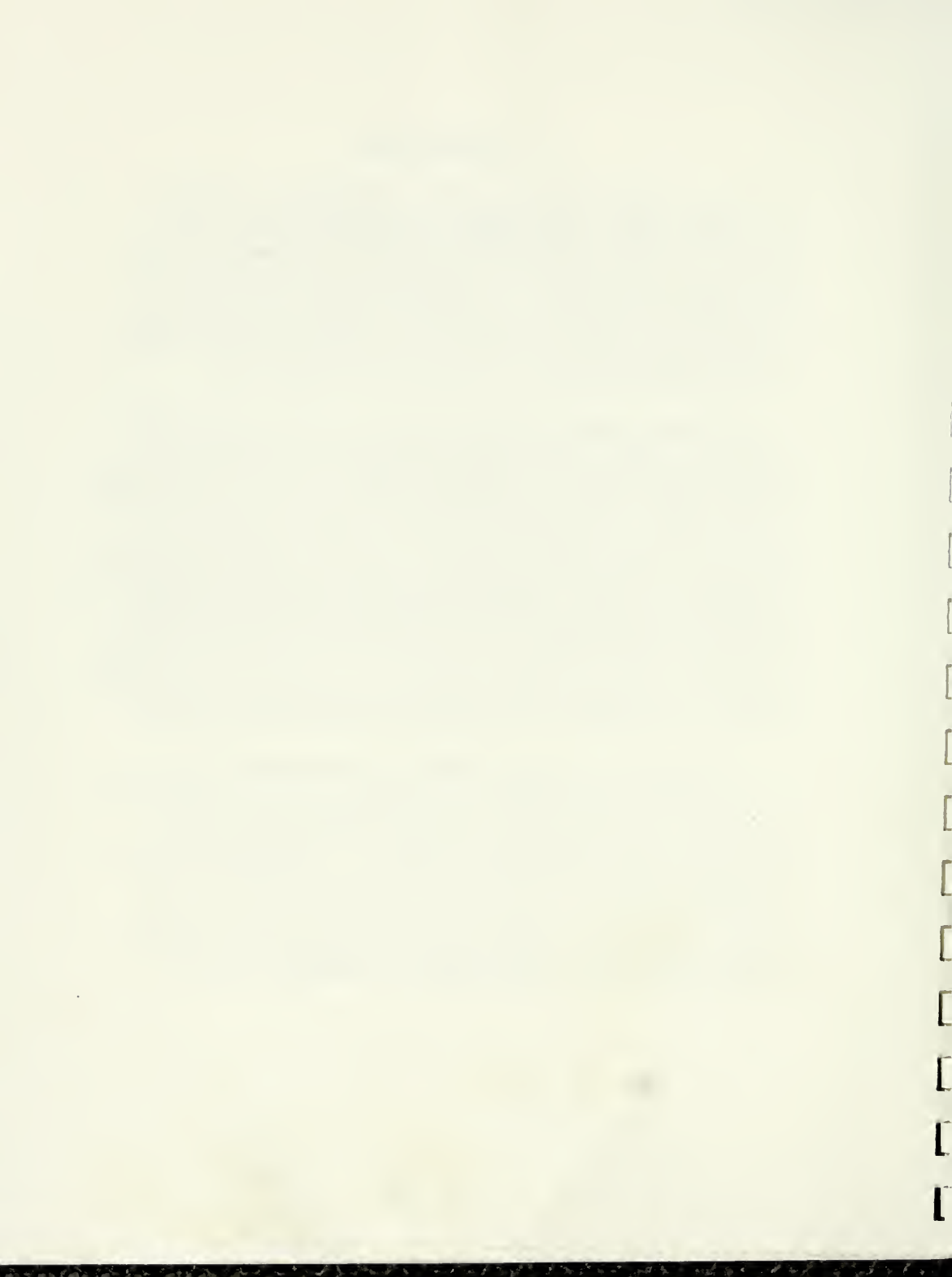


2. GENERAL APPROACH

Numerous factors influence the level of wages paid to workers in each economic sector. Among these are the demand for various skill levels, the size of the labor force available; the composition of the labor force in terms of age, sex, and skills; worker productivity; and established wage scales/laws. In addition, the wages paid in a sector are influenced by the cost of living in the local area and by the wage rates for comparable skills at the state and national levels.

The general approach followed in this research paper was to first identify and discuss the relationship among some of the major factors that affect wage levels in the economic sectors. Second, the wages paid in each sector of the Sheridan economy were compared with the state and national wage levels for that sector, and with the mining wages in the Decker area. This was done to examine the sectoral trends in wages and to identify any apparent relationship between mine wages and sectoral wages in the local economy. Both individual sectors and the aggregate nonmining wages were examined in this manner. Third, for those economic sectors which showed a possible effect from mine wage rates, statistical analyses were performed to test and quantify the mine wage influence.

The discussion of the wage effects of the mining sector in the Decker study area is presented in the sequence in which the analysis was performed. The discussion of the factors affecting wage levels is presented in the following section, Section 3. The examination of the local economy and the trends in local, state, and national wages is presented in Section 4. The impacts of mine wages on wages in other economic sectors of the Decker study area are summarized in Section 5. The conclusions of this research paper are presented in Section 6.



3. FACTORS AFFECTING WAGE LEVELS

In the context of a labor market model, the wage rate in an economic sector would be defined as a function of the demand and supply for labor in that sector. The demand for labor is dependent upon the diversity of the local economy, the number of firms in each sector, and the job skills required by these firms. In general, the more diverse the local economy, the more employers there will be and the more diversified will be the job skills required. Diversification thus tends to increase the demand for labor as well as the variety of labor skills required to meet the labor demand.

The supply of labor is dependent upon the composition of the work force in terms of age, sex, and job skills available. Improved communications and work force mobility have greatly expanded the labor skills that can be available to the local economy by increasing the speed with which new people can identify jobs and move to an area in response to labor demand.

The balancing of the labor demand and supply is one of the major dynamics in the competition for labor issue. Other factors also influence the availability of and demands for labor and thereby influence wages. These other factors include institutionalized wage scales, such as those resulting from unionization or interorganizational standards (for example, government jobs where the wages are defined on a regional or national level). Government regulations such as minimum wage laws and Social Security tax influence the total cost of labor to an employer and thus affect the demand for labor. Factors such as worker productivity, working conditions, and general economic conditions can influence both the demand and supply of labor in a local economy.

The effect of differential wage scales among the economic sectors of the local economy is a complex issue and, to some extent, is dependent upon the specifics of the local economic conditions. In order to better

understand the wage effects in the Decker study area the following section presents an historical overview of employment, income, and wages in the Decker study area economy.

4. HISTORICAL OVERVIEW: COMPARISON OF TRENDS IN SECTORAL WAGES

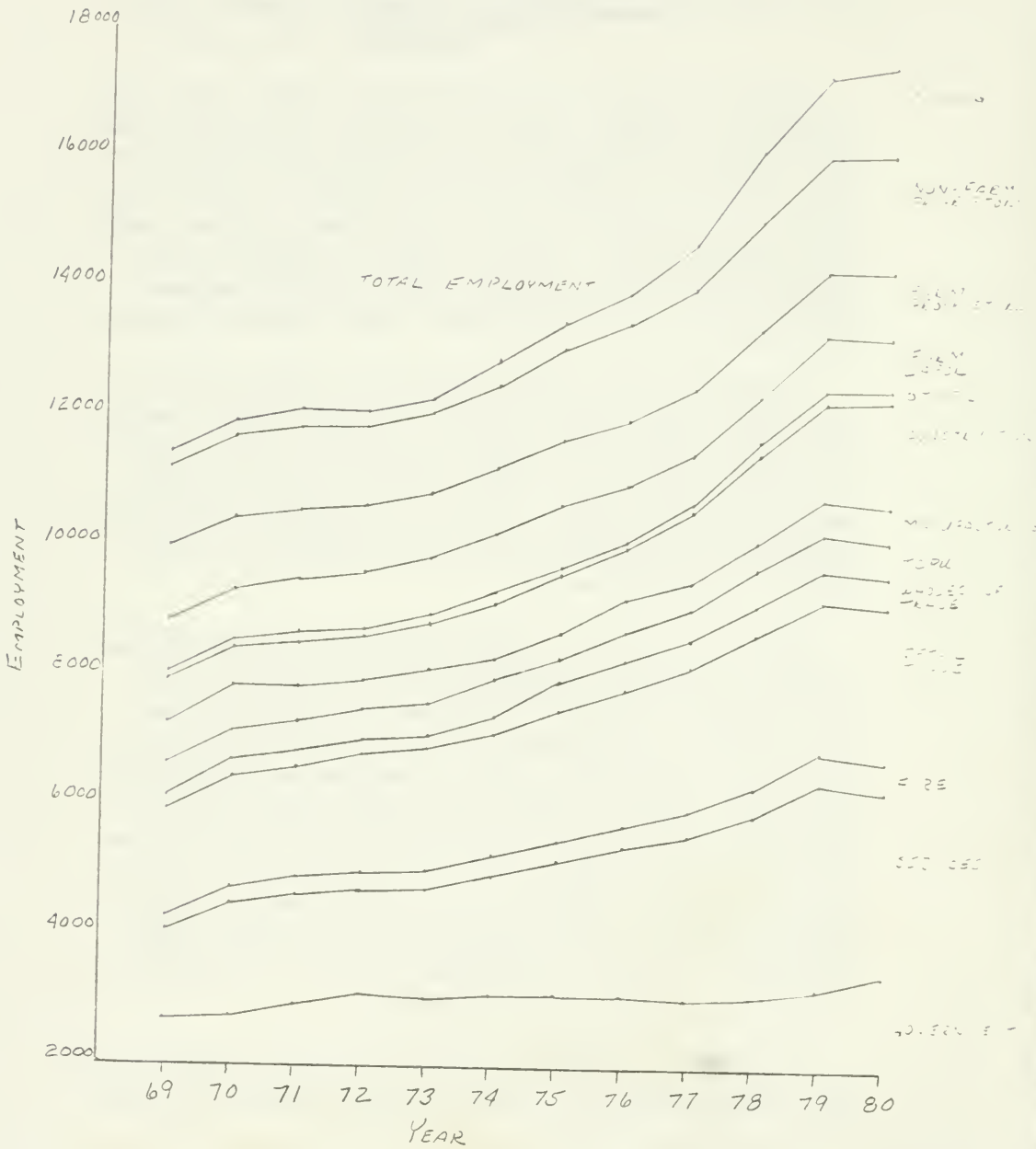
The Decker study area is comprised of Big Horn County, Montana and Sheridan County, Wyoming. Sheridan County serves as the regional trade center for parts of southeastern Montana and northeastern Wyoming. As shown in Figure 1, in the early 1970s, the economy of the study area was predominantly centered around jobs in the government, services, trade, and agricultural sectors. By the late 1970s, the expansion of coal surface mining in the area had caused greatly increased employment opportunities in the mining construction, trade, and service sectors.

The composition of labor and proprietors real income during the 1970s reflects similar trends. However, as shown in Figure 2, compared to employment, growth in real income was more rapid and more highly concentrated in the mining and construction sectors due to the high average wage in these sectors. Income in the government, services, and trade sectors also increased although not as dramatically as in the mining and construction sectors.

The growth in mining real income corresponded with rapid increases in mining real wages that accompanied the rapid expansion of mining sector employment. Figures 3 and 3a present the comparison of the mining wages in the Decker study area first to those in Big Horn and Sheridan counties and then to those in Wyoming and the United States. Mining wages in the Decker study area followed a pattern similar to national and Wyoming wages, although rising slightly faster after 1974. Rapid growth in mining wages began in 1971 as coal prices and mining activities increased in response to rising energy demand, to efforts at conversion from oil, and to a national interest in attaining energy independence. The effect of these factors were felt on mining wages at the study area, regional, and national levels.

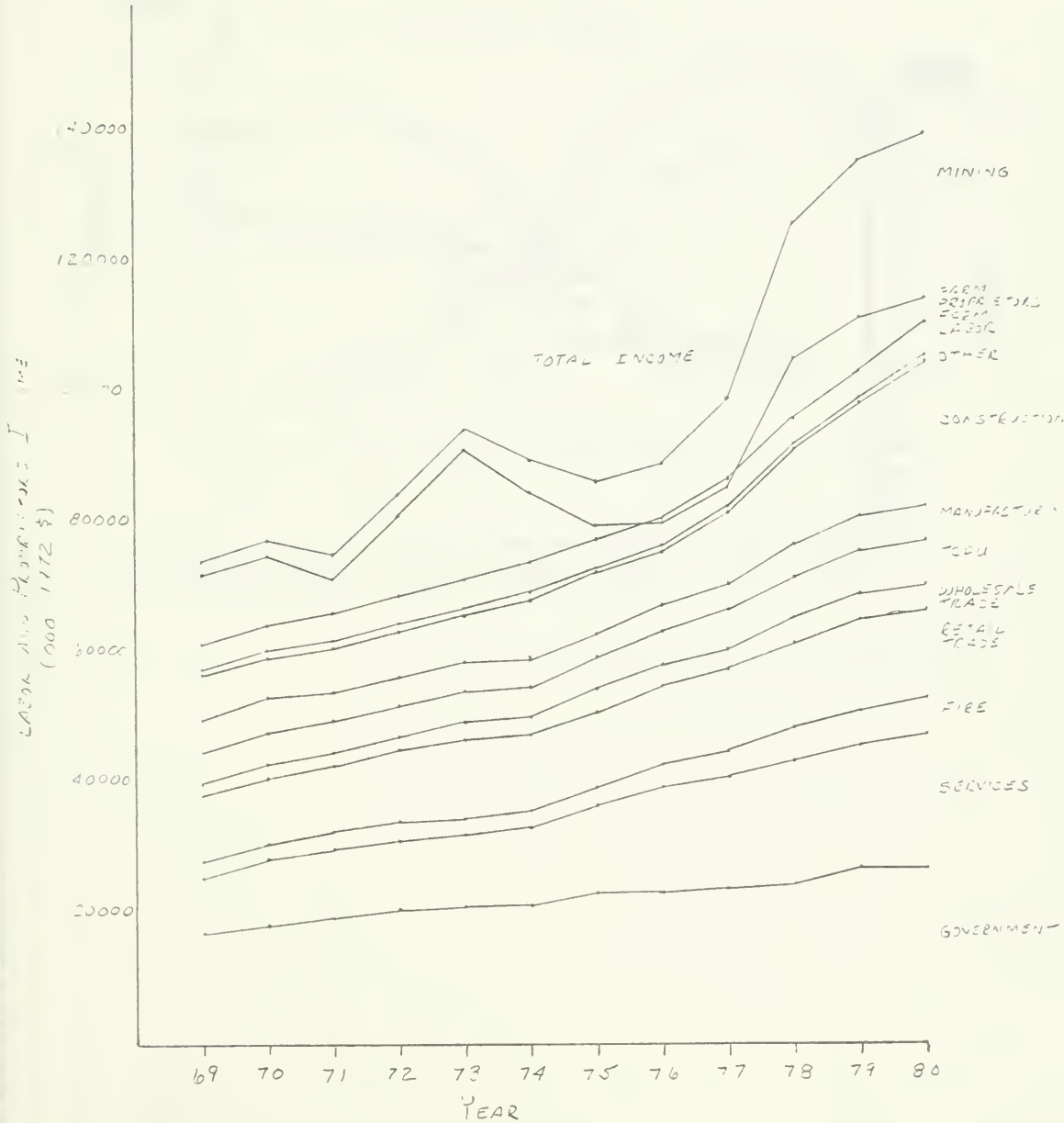
A rapid increase in real mining wages would imply an increase in all other wages if competition for labor were solely a function of supply

FIGURE 1
 FULL- AND PART-TIME EMPLOYMENT BY SECTOR
 DECKER STUDY REGION
 1969-1980



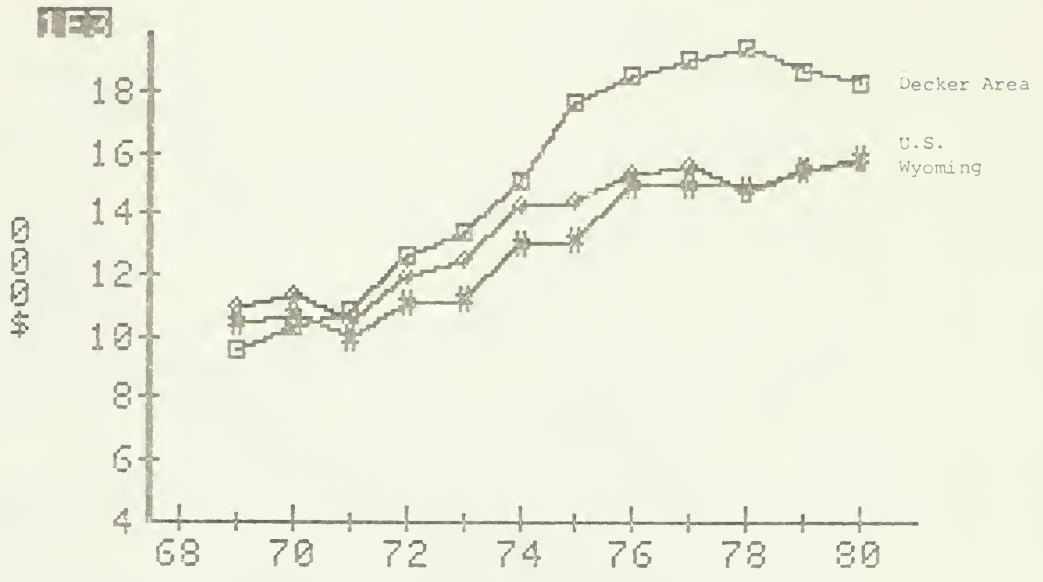
Source: Mountain West Research-North, Inc., 1983.

FIGURE 2
 LABOR AND PROPRIETORS INCOME BY SECTOR
 DALLAS STUDY REGION
 1969-1980



Source: Mountain West Research-North, Inc., 1983.

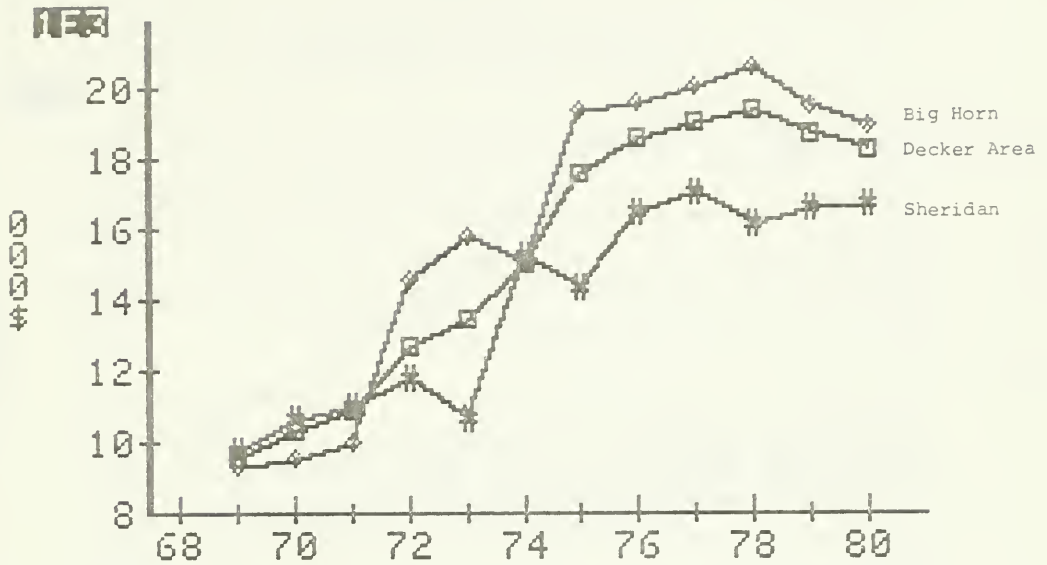
FIGURE 3
MINE WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 3a

DECKER AREA MINE WAGES



Source: Mountain West Research-North, Inc., 1983.

and demand and the availability of labor was a constraining factor. Since Sheridan serves as the regional trade center and is centrally located for all the mining activity in the study area, the competition for labor would be expected to be most noticeable in Sheridan County. If this effect were pronounced, one should see a relative increase in nonmine wages in Sheridan County compared to state and national wages during the period of rapidly increasing mine employment and wages (1971-1977 especially). To determine whether such increases occurred, real wages in all other sectors (nonmining) and in each of the major sectors individually for Sheridan County, Wyoming and the United States were plotted against real mine wages in the study area.

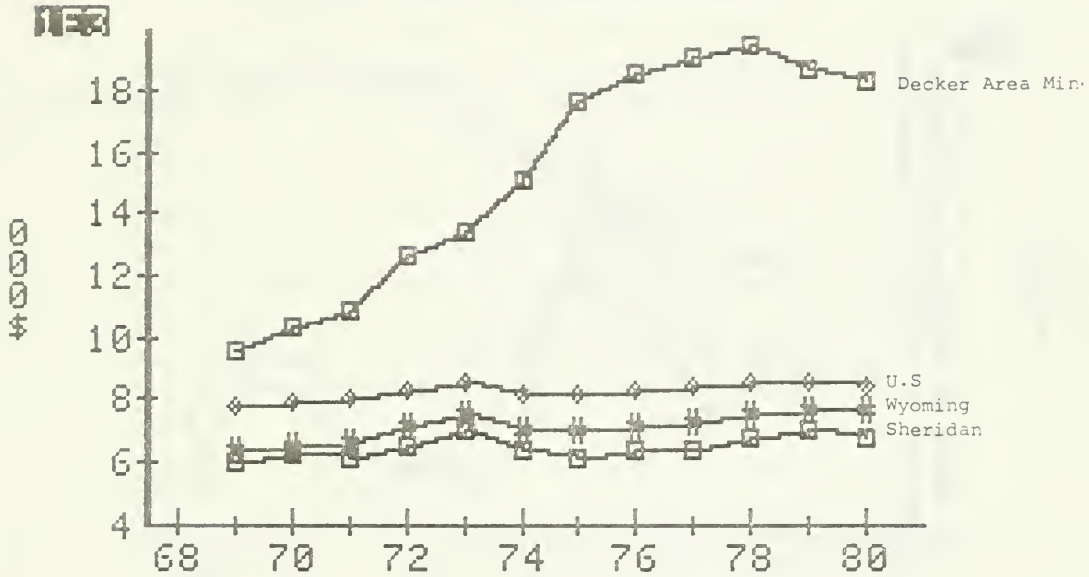
As shown in Figure 4, the escalation of the mining wage, and expansion of the mining sector employment did not have a significant effect on real wages in all nonmining sectors taken together (all other sectors). Rather, real wages in all other sectors (nonmining) in Sheridan County closely followed state and national trends for this aggregation of sectors, although at a slightly lower level. The reasons for the lack of increase in the real wages in the nonmining sectors of the study area were probably the rapid increase in the labor force available in the area due to in-migration and the increase in labor force participation brought about by the rapid national inflation of the 1970s.

Although the average real wages of all other sectors did not increase with the increase in real mining wages, the patterns of individual economic sectors were not uniform. The trends in real wages in individual economic sectors in Sheridan County varied dramatically as did the national and state wages per sector.

The widest variation in real wages was shown among farm proprietors (see Figure 5). Farm proprietors real wages peaked in 1973 with cyclical variations thereafter, although in a general downward trend. State and national trends reflect similar circumstances. At first glance, the farm proprietors wages seem to run countercyclical to mining wages, however, since the farm proprietors wages are strongly influenced

FIGURE 4

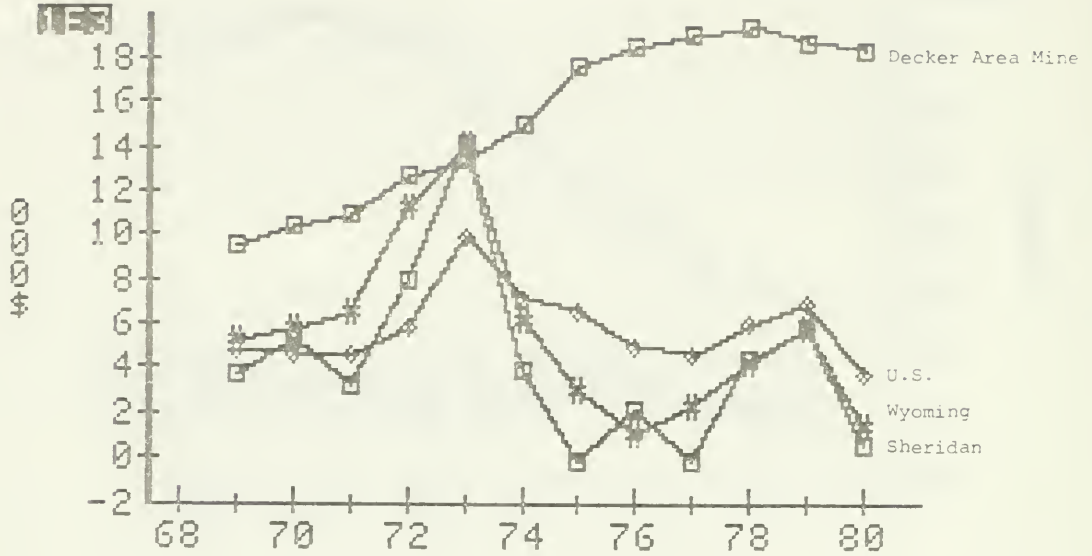
NONMINING WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 5

FARM PROPRIETORS WAGES



Source: Mountain West Research-North, Inc., 1983.

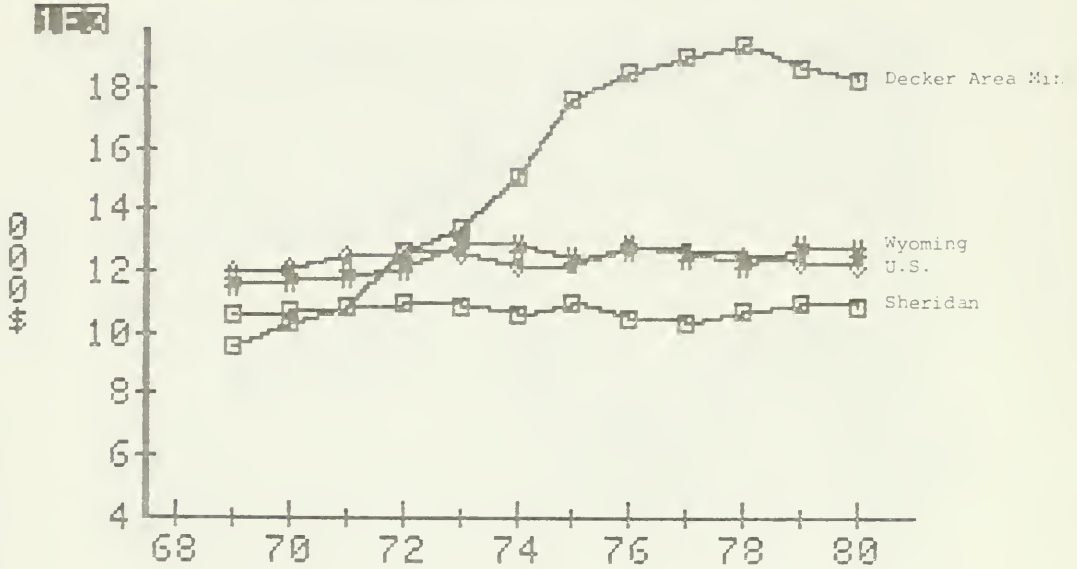
by the costs of production, volume of production, and international trade of farm products, it appears unlikely that mine wages played an important role in farm proprietors' wages.

Wages in the construction sector would be expected to be closely linked with the mining wage due to their interdependence in job skill requirements. As shown in Figure 6, however, the mining wage increases do not appear to have affected the construction wage in Sheridan County to any significant extent. The construction wage in Sheridan County followed the state and national trends fairly closely, although reflecting somewhat more stability. The close relationship between national, state, and county wages in the construction sector makes the construction wage appear more directly affected by the transient nature of contract construction and the high level of union jobs in the construction sector than by mine sector wages.

Similarly, the manufacturing and transportation, communication, and public utilities (TCPU) sectors' wages followed national and state trends with little apparent effect from the increased mining employment or mining wage. As shown in Figure 7, manufacturing wages generally followed the upward national trend, although more slowly and with minor deviations due to adjustments in the manufacturing sector in the study area during the 1970s. Despite the high increase in mining wages in the study area, manufacturing sector wages in Sheridan County were further below state and national levels in 1980 than in 1970, strongly indicating a lack of relationship between mining and manufacturing wages. The TCPU sector wages in the study area, presented in Figure 8, showed an upward trend (as did the state and national wages in this sector) indicating a possibility of mine sector effects. The transportation sector in the study area is dominated by railroad employment which is closely linked with the mining sector for the transportation of coal. However, it is known that wages in the local transportation sector are heavily influenced by union contracts with the railroad which are therefore expected to have had a greater effect than the mining wages. Their correspondence with the national and state trends supports this latter analysis.

FIGURE 6

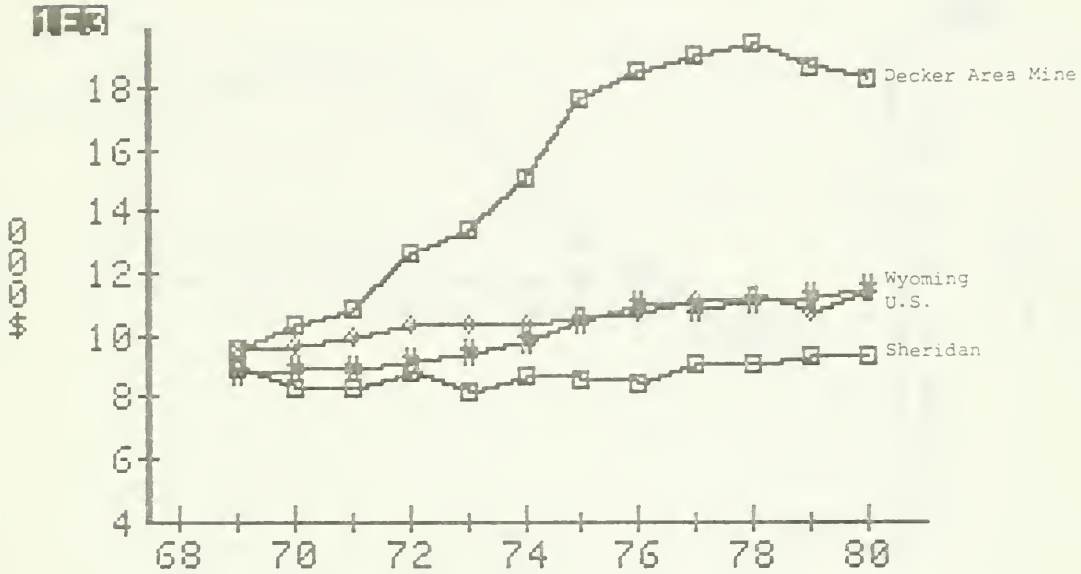
CONSTRUCTION WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 7

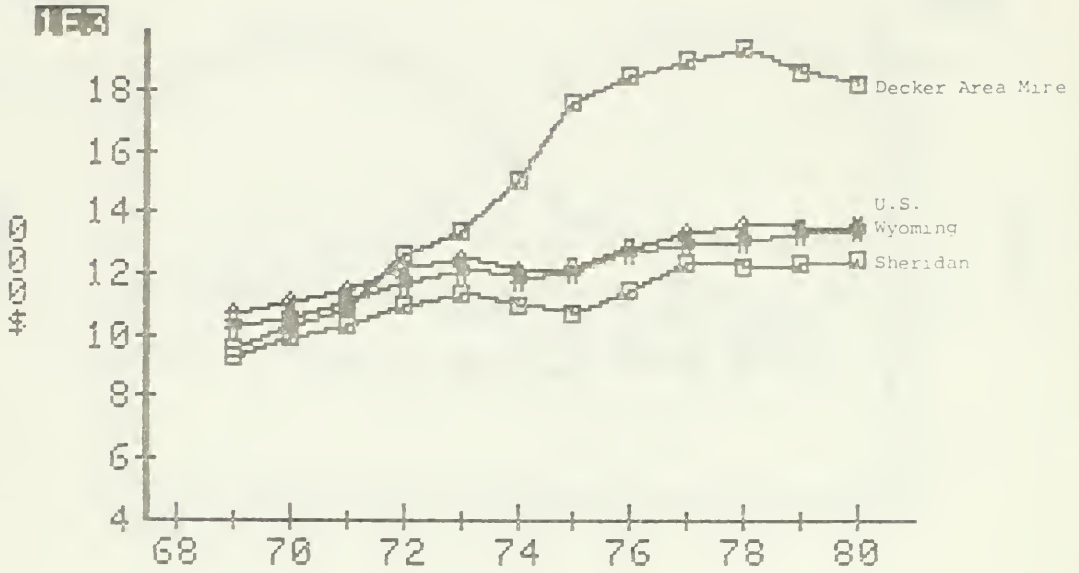
MANUFACTURING WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 8

T.C.P.U. WAGES

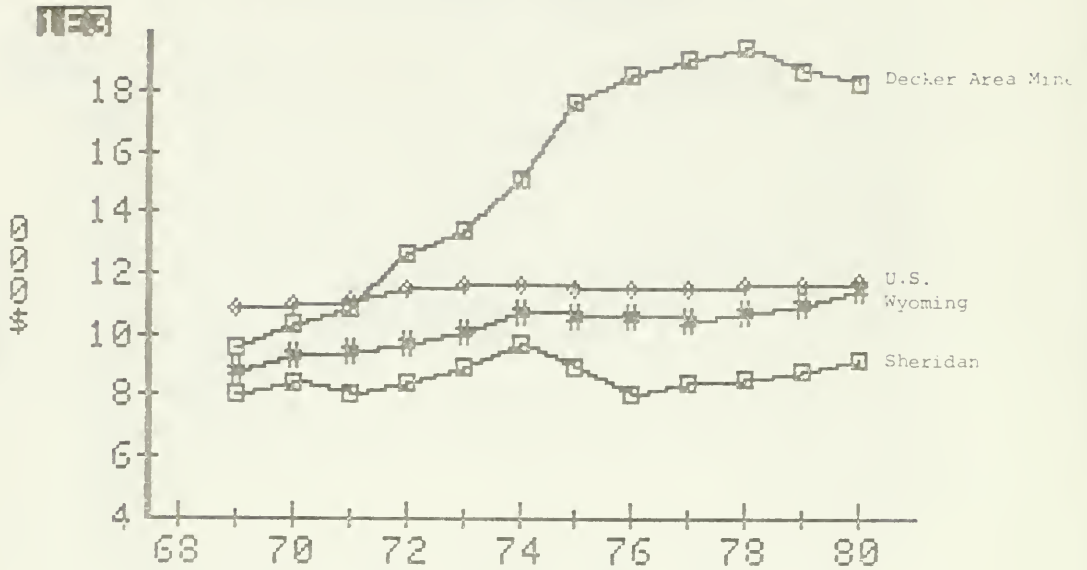


Source: Mountain West Research-North, Inc., 1983.

The relationship between mining wages and the wages in the remaining economic sectors of wholesale trade; retail trade; finance, insurance, real estate (FIRE); services; and government are presented in figures 9 through 13. The sectoral trends in wages in the study area follow trends similar to those of the state and the nation. The effect of the increase in the mining wage on wages in these sectors thus appears to be minimal: the wages in the study area did not increase relative to state and national levels during the period of rapid increase in mine employment and wages. Trade sector wages are almost identical to national wages, particularly in retail trade. Wholesale trade wages followed the national trend; however, the wholesale trade sector in the study area was more noticeably affected by the 1974 recession than was either the state or the nation. Finance, insurance, and real estate (FIRE) wages also followed national trends reflecting the growth in housing during the 1970s with the exception of the 1974 recession. Services and government wages in the Decker study area followed trends nearly identical to the state and the nation and at approximately the same wage levels.

FIGURE 9

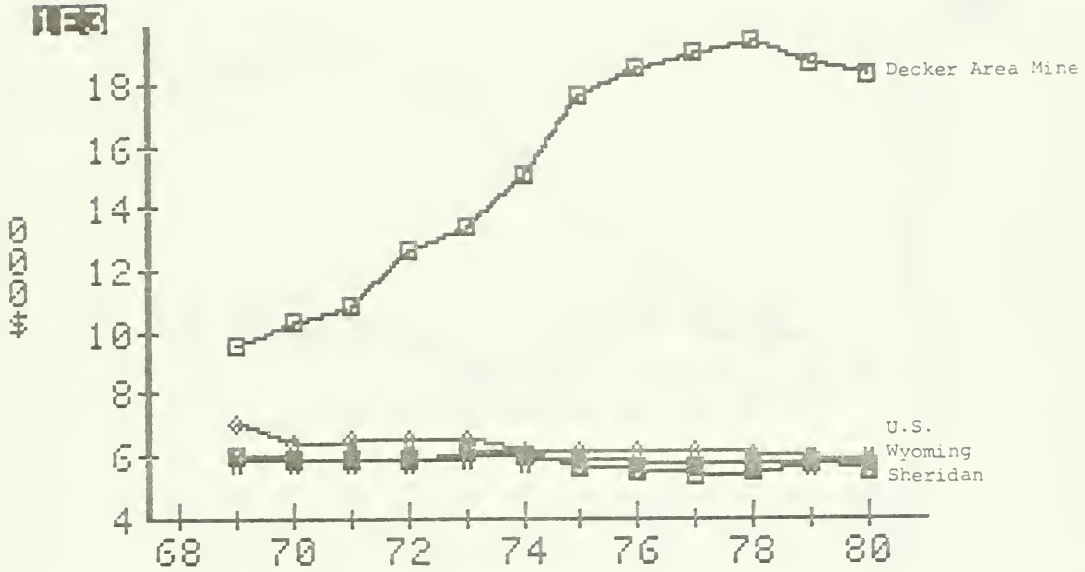
WHOLESALE TRADE WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 10

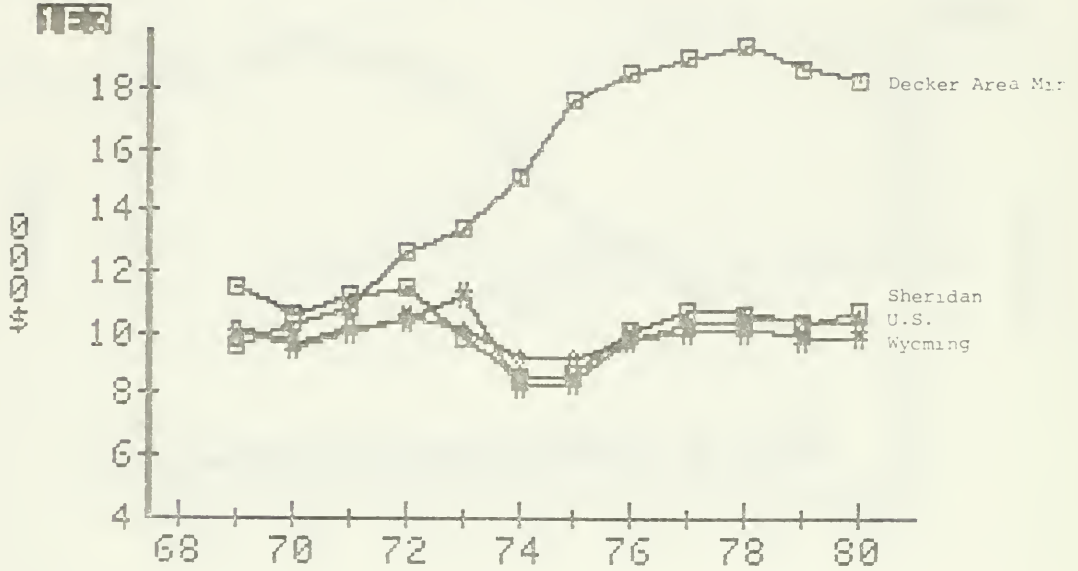
RETAIL TRADE WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 11

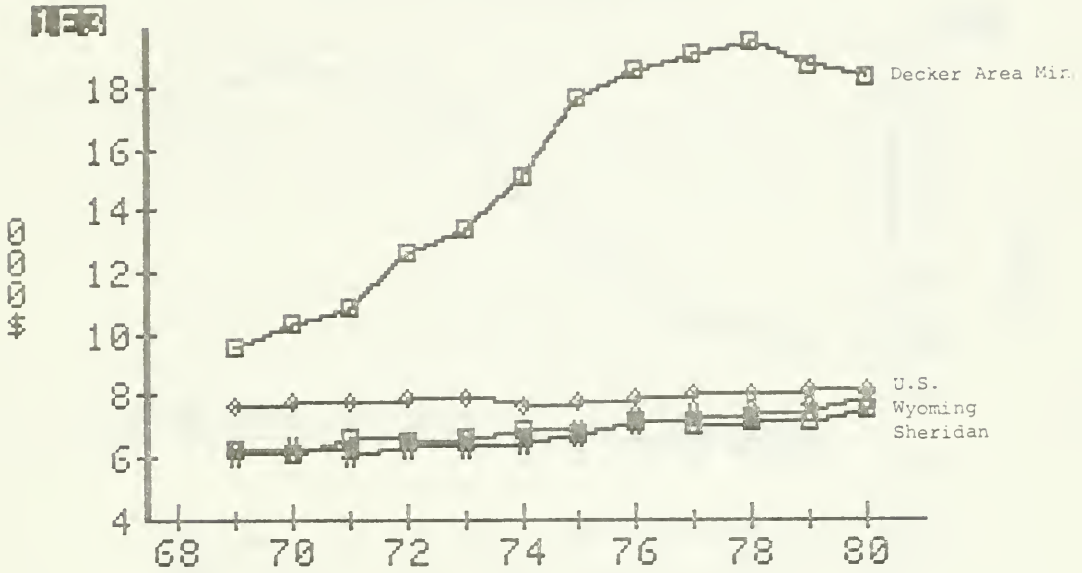
F.I.R.E. WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 12

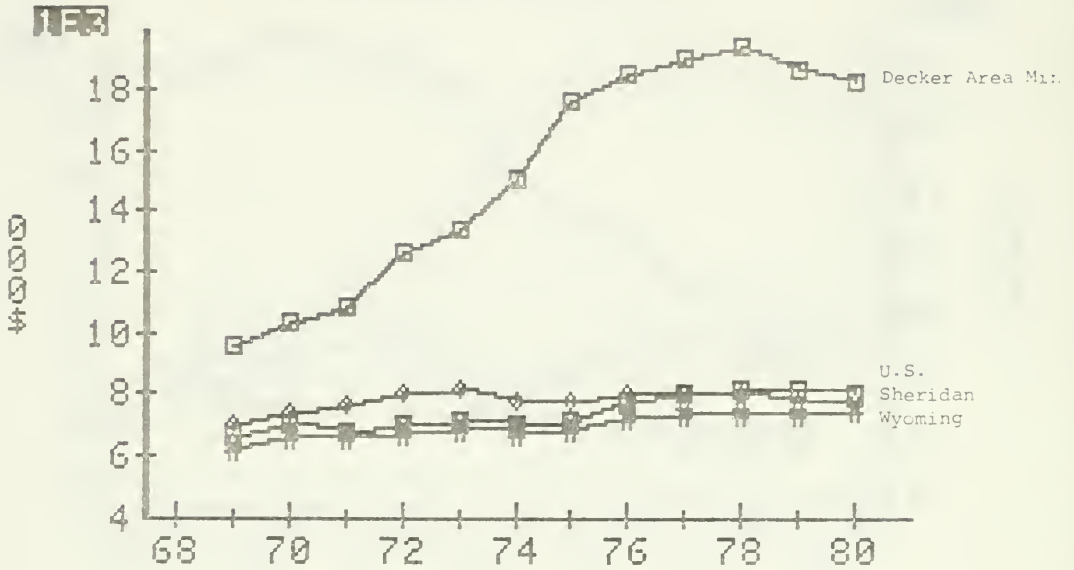
SERVICES WAGES



Source: Mountain West Research-North, Inc., 1983.

FIGURE 13

GOVERNMENT WAGES



Source: Mountain West Research-North, Inc., 1983.

5. STATISTICAL RELATIONSHIPS

The effect of the mining wage on wages in other sectors was statistically tested by the use of an econometric model that equated labor demand and labor supply. The econometric equation was utilized to identify the relationship between mining wages and other sectoral wages and to estimate the magnitude of the effect of mine wages on wages in other sectors. The results of the statistical analysis are summarized below.

The model developed for this study is based on the premise that the wage rate in any one sector is a function of the wage rates in the other sectors, the total availability of workers, and the income of the proprietors in the local economy. The exact model that was tested in this study is a single equation specification as listed below.

$$Y_i = \alpha + B_1X_1 + B_2X_2 + B_3X_3 + e$$

where:

y_i = The annual per worker real earnings in the industrial sector

α = The constant term

B = Regression coefficients

x_1 = The annual per worker real earnings in the mining sector

x_2 = The annual per worker real earnings of nonfarm proprietors

x_3 = The average annual unemployment rate

e = Error term

The model was tested for three distinct cases: (1) to determine the impact that the mining activities in Big Horn County have had on other sector wages in Big Horn County, (2) to determine the impact that the mining wage in Sheridan County has had on the wages in other sectors in that county (Sheridan 1 scenario), and (3) to determine the impact that the mining wage rate in Big Horn County has had on the wage rates in the other sectors in Sheridan County (Sheridan 2 scenario). As discussed earlier, the third case was included because the majority of the mine

employment in the area was in Big Horn County but, a significant portion of the mine workers from Big Horn County actually resided in Sheridan County. Therefore, it was thought that the wage rates in Sheridan County might be more influenced by the mining wage rate in Big Horn County than of the mining wage rate in Sheridan County.

Table 1 presents the R^2 of the model specification for each sector and scenario. The R^2 provides an indication of the fit of the model to the data points, the higher the R^2 the better the fit. As expected from the trends discussed in Section 4, the R^2 ranged from a low of 0.025 for the agricultural sector in the Sheridan 2 scenario to a high of 0.883 for the government sector in the Big Horn scenario. The government sector had the highest R^2 across the scenarios, ranging from 0.76 to 0.883. The manufacturing, TCPU, and services sectors each had an R^2 above 0.70 for at least two of the three scenarios. In all of the remaining sectors the R^2 was below 0.70 in at least two of the three scenarios.

Table 2 presents the coefficient estimate and statistics on the mining wage independent variable for each sector and scenario. The coefficient estimate on the mining wage rate is of particular importance because it should provide some indication of the relationship of the mining wage to the wage rates in the other sectors. Economic theory suggests that the higher the wage rate in the mining or competing sector the higher the wage rate in the other sectors. Therefore, the sign of this coefficient estimate is expected to be positive. As seen in the table, however, the coefficient estimate for all three scenarios had the correct sign in only four of the sectors: manufacturing, TCPU, service, and government. In most cases for these sectors the coefficient estimates were also statistically significant at the 90 percent level. In all the remaining sectors the coefficient was either the wrong sign, statistically insignificant, or both.

Table 3 presents the elasticity of each sector's wage with respect to the mining wage rate. The elasticity indicates how responsive the wage rate in a particular sector is to changes in the mining wage rate.

TABLE 1
R² of Regression Equations

	Big Horn	Sheridan 1	Sheridan 2
Agricultural Labor (Y ₁)	0.168	0.565	0.025
Construction (Y ₃)	0.289	0.125	0.628
Manufacturing (Y ₄)	0.038	0.726	0.798
TCPU (Y ₅)	0.870	0.722	0.113
Retail Trade (Y ₆)	0.124	0.121	0.692
Wholesale Trade (Y ₇)	0.446	0.792	0.246
FIRE (Y ₈)	0.382	0.229	0.761
Services (Y ₉)	0.320	0.807	0.861
Government (Y ₁₀)	0.883	0.855	0.760

Source: Mountain West Research-North, Inc., 1983.

TABLE 2

Coefficient Estimate and t-Statistics on Mining Wage

	Big Horn		Sheridan 1		Sheridan 2	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Agricultural Labor (Y_1)	-0.0148	-0.5892	0.0370	1.108	0.0417	1.925
Construction (Y_3)	0.3532	1.766	-0.0250	-0.9892	-0.0045	-0.2327
Manufacturing (Y_4)	0.0131	0.1976	0.1182	3.598	0.0762	2.722
TCPU (Y_5)	0.2037	7.295	0.2937	4.045	0.2284	5.047
Retail Trade (Y_6)	-0.0073	-0.3187	0.0676	1.0367	0.0476	0.9955
Wholesale Trade (Y_7)	-0.1120	-2.126	-0.0620	-4.295	-0.0402	-3.135
FIRE (Y_8)	-0.0065	-0.0727	-0.1599	-1.453	-0.1214	-1.527
Services (Y_9)	0.0953	1.699	0.1204	5.137	0.0847	4.440
Government (Y_{10})	0.1173	6.129	0.1501	5.138	0.1103	5.279

Source: Mountain West Research-North, Inc., 1983.

TABLE 3

Elasticity of Mining Wage Coefficient

	Big Horn	Sheridan 1	Sheridan 2
Agricultural Labor (Y_1)	-0.0464	0.0910	0.1180
Construction (Y_3)	0.4930	-0.0322	-0.0067
Manufacturing (Y_4)	0.0286	0.1888	0.1399
TCPU (Y_5)	0.3157	0.3628	0.3244
Retail Trade (Y_6)	-0.0172	0.1086	0.0880
Wholesale Trade (Y_7)	-0.2414	-0.1497	-0.1118
FIRE (Y_8)	-0.0119	-0.2135	-0.0068
Services (Y_9)	0.2487	0.2450	0.1982
Government (Y_{10})	0.2773	0.2811	0.2376

Source: Mountain West Research-North, Inc., 1983.

For example, an elasticity of .20 indicates that a 100 percent change in the mining wage rate would cause a 20 percent change in the wage rate in that sector.

The TCPU sector demonstrates the highest degree of sensitivity to a change in the mining wage rate. In all cases, the TCPU wage was found to increase by at least 30 percent of the corresponding percentage increase in mining wages (i.e. if mine wages increased by 100 percent, TCPU wages increased by at least 30 percent). The service and government sectors were found to have elasticities of 0.20 or more.

Tables 4 and 5 present the coefficient estimates and the t-statistics for the variables of unemployment and proprietor's income. The coefficient on the unemployment variable is expected to be negative. That is, as the unemployment rate goes down, the wage rates in a particular sector are expected to increase due to increase competition for the limited work force. In most cases, for each scenario and sector the coefficient estimate on the unemployment rate was the wrong sign. In all cases the coefficient estimate was not statistically significant. The coefficient estimate on the proprietor's income is expected to be positive. As the proprietor's income increases, the wage rate in other sectors is expected to increase. In only a few cases are the coefficient estimates of the expected sign. In most cases the estimates are not statistically significant. In general, these two variables added very little to the explanatory power of the model. They proved to have either the wrong sign, be statistically insignificant, or both in most sectors for all three scenarios.

The statistical analysis of the effects of the mining wage or wages in other sectors revealed results similar to the general discussion presented in Section 4. Overall, the mining wage did not have any discernable effect on the wage rate in another economic sector. For all sectors, except manufacturing, TCPU, services, and government, no discernable effect was identified between the mining wage and the wages in that sector. In the case of manufacturing, TCPU, and government, the correlation between mining wages and wages in these sectors was 0.72 or

TABLE 4

Coefficient Estimate and t-Statistic on Unemployment Rate

	Big Horn		Sheridan 1		Sheridan 2	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Agricultural Labor (Y_1)	98.658	1.078	13.995	0.0727	20.151	0.1182
Construction (Y_3)	693.265	-0.9478	1.099	0.0075	13.064	0.0851
Manufacturing (Y_4)	-132.243	-0.5450	-61.184	-0.3233	-80.426	-0.3651
TCPU (Y_5)	-417.757	-4.091	-250.928	-0.5997	-272.062	-0.7635
Retail Trade (Y_6)	50.843	0.6075	28.960	0.0771	20.734	0.0550
Wholesale Trade (Y_7)	286.926	1.490	-169.943	-2.042	-160.058	-1.582
FIRE (Y_8)	-548.525	-1.667	-31.460	-0.0496	-17.995	-0.0287
Services (Y_9)	-6.648	-0.0324	85.333	0.6316	70.565	0.4697
Government (Y_{10})	78.812	1.126	-208.234	-1.237	-223.398	-1.357

Source: Mountain West Research-North, Inc., 1983.

TABLE 5

Coefficient Estimate and t-Statistic Nonagricultural Proprietors

	Big Horn		Sheridan 1		Sheridan 2	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Agricultural Labor (Y_1)	0.1699	0.9460	0.2990	-2.317	-0.2871	-2.552
Construction (Y_3)	-1.050	-0.7321	-0.0687	-0.7032	-0.0437	-0.4318
Manufacturing (Y_4)	-0.0178	-0.0375	0.1371	-1.081	-0.1788	-1.231
TCPU (Y_5)	-0.4197	-2.096	0.0032	0.0115	-0.0459	-0.1954
Retail Trade (Y_6)	0.1647	1.003	0.1259	0.04996	0.1077	0.4333
Wholesale Trade (Y_7)	-0.2591	-0.6861	0.1047	1.877	0.1262	1.890
FIRE (Y_8)	0.4154	0.6438	-0.4074	-0.9581	-0.3767	-0.9117
Services (Y_9)	-0.0153	-0.0379	-0.0660	-0.7284	-0.0986	-0.9949
Government (Y_{10})	-0.0111	-0.0807	-0.1660	-1.471	-0.2001	-1.842

Source: Mountain West Research-North, Inc., 1983.

higher. Based on the previous analysis, this high degree of correlation appears to be attributable more to the fact that the manufacturing and TCPU sectors are highly unionized, as is the mining sector, and that national trends for wages in these sectors were similar, rather than to a local effect of mine wage increases. The wage scale for union jobs tends to be set at regional and national levels and there is frequently correspondence between union agreements in different sectors. Since the trends for both mine and government wages at the local, state, and national levels were all generally upward, statistical correlation between mine wages and local government wages is not convincing evidence of a direct or causal relationship. The TCPU sector, which showed the highest correlation to the mining wage, is dominated in Sheridan County by railroad employment which did have a direct relationship to coal production. Even here, however, the Sheridan County wages appeared to follow state and national trends more closely than mine sector trends, though over the 1970-1980 period, wages in both sectors tended to increase.

The effect of the mining wage on service wages is attributable partly to the increased demand for service jobs created by the mining activity itself and by the service needs of a growing population. Increased mining thus led to an increase in services employment and appears to have caused a small increase in the real wages in the service sector, which may, therefore, genuinely reflect some local consequence of high mine wages and employment. As seen in Figure 12, the fact that state and local wages in the service sector rose relative to national wages over the 1970-1980 period support this conclusion.

Overall, however, despite upward trends in real wages in some sectors over the 1970-1980 period which yield statistical correlations with mine wages (because they were also increasing), analysis reveals the impact of the mining wage on the wage rates in other sectors to be small or nonexistent; state and national trends appear to have been far more important. In the sectors where a case could be made that an effect was discernable, the elasticities -- the responsiveness to changes in the real mining wage -- were relatively small. For this

reason, an increase in the real wage in mining sufficient to produce a significant increase in the real wage rate in any other sectors is highly unlikely.

6. CONCLUSIONS

The analysis of the effects of the rapid increase in real mining wage on the real wages in other economic sectors in the Decker study area was approached from two general perspectives. The first perspective was to compare the real wages in mining to the real wages in other sectors by examining the trends of wages in the Decker study area, the state and the nation over the 1969-1980 period. The second perspective was to statistically analyze the wage rate relationship in order to quantify the effect of the mining wage on wages in the other sectors of the Decker study area economy.

From both perspectives, the effect of the mining wage on the wages in other sectors was determined to be minimal. In all cases, other factors played a more significant role in determining real wages than did the mining wage. From the analysis, general economic trends at the state and national level, combined with mechanisms that prevented local labor shortages (in-migration, increased labor force participation) appeared to be of greatest importance. The effect of these other factors indicates the economic interdependence among various regions of the nation as well as the fact that as high growth areas increase in population they trend toward the national norm in terms of population and economic characteristics.

